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EXAMINER

SOWARD, IDA M

ART UNIT

PAPER NUMBER

2822

DATE MAILED: 12/26/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/844,347

Applicant(s)

ZENG, JUN

Examiner

Ida M Soward

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any claimed patent term adjustment. See 37 CFR 1.704(b).

1) ☒ Responsive to communication(s) filed on 13 November 2002.

2a) ☐ This action is FINAL.

2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

4) ☒ Claim(s) 23-39 is/are pending in the application.

4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.

5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.

6) ☒ Claim(s) 23-39 is/are rejected.

7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.

8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☐ All b) ☐ Some \* c) ☐ None of:

1) ☐ Certified copies of the priority documents have been received.

2) ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.

3) ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) g.

4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other:

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## DETAILED ACTION

This Office Action is in response to the Applicant's amendment filed November 13, 2002.

### *Claim Rejections - 35 USC § 102*

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 23-24 are rejected under 35 U.S.C. 102(a) as being anticipated by  
Admitted Prior Art Figures 1 and 3a-3b.

Prior Art Figures 1 and 3a-3b teach a semiconductor layer **9** having a trench **14** therein; a gate dielectric layer **24** lining the trench; a gate conducting layer **12** in a lower portion of the trench; a dielectric layer **20** in an upper portion of the trench and extending outwardly from the semiconductor layer; source regions **26** adjacent the outwardly extending dielectric layer; source/body contact regions **18** laterally spaced from the gate conducting layer and non-interruptibly contacting the source regions; and a source electrode **22** on the source regions and on the dielectric layer.

### *Claim Rejections - 35 USC § 103*

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The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 25, 27, 32 and 36-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Prior Art Figures 1 and 3a-3b as applied to claims 23-24 above, and further in view of Gilbert et al. (5,349,224).

Prior Art Figures 1 and 3a-3b teach all mentioned in the rejection above. Prior Art Figures 1 and 3a-3b further teach a source electrode **22** on the source regions **26**, on the dielectric layer **20**, and on the source/body contact regions **18**; a gate dielectric layer **24** lining the trench. However, Prior Art Figures 1 and 3a-3b fail to teach at least one conductive via between the source electrode and the source/body contact region. Gilbert et al. teach at least one conductive via between the source electrode **90** and the source/body contact region **64** (Figure 5F). Gilbert et al. further teach the source electrode on the source region, on the dielectric layer and on the conductive via; and an opening exposing the source/body contact region, wherein the source/body contact regions are exposed by an opening in the source region (Figure 5F). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the MOSFET of Prior Art Figures 1 and 3a-3b and with the MOSFET having conductive vias of Gilbert et al. to be readily integrable in a semiconductor integrated circuit (col. 1, lines 6-11).

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Claims 26, 30 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Prior Art Figures 1 and 3a-3b and Gilbert et al. (5,349,224) as applied to claims 23-24 above, and further in view of Grabowski et al. (6,140,678).

Prior Art Figures 1 and 3a-3b and Gilbert et al. teach all mentioned in the rejections above. However, Prior Art Figures 1 and 3a-3b and Gilbert et al. fail to teach a recess over the source/body contact regions wherein the source/body contact regions are recessed within the semiconductor layer adjacent the source regions. Grabowski et al. teach a recess over the source/body contact regions **33** wherein the source/body contact regions are recessed within the semiconductor layer **14** adjacent the source regions **34** (Figure 4A). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the MOSFET of Prior Art Figures 1 and 3a-3b and MOSFET having conductive vias of Gilbert et al. with the MOSFET having recessed areas of Grabowski et al. to reduce hot carrier injection (col. 1, lines 46-65).

Claim 29, 31, 35 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Prior Art Figures 1 and 3a-3b and Gilbert et al. (5,349,224) as applied to claim 23-24 above, and further in view of Shih et al. (5,283,452).

Prior Art Figures 1 and 3a-3b and Gilbert et al. teach all mentioned in the rejections above. However, Prior Art Figures 1 and 3a-3b and Gilbert et al. fail to teach a gate recess depth within a range of 0.2 to 0.8 microns. Shih et al. teach a gate recess depth of 0.25 microns (col. 5, lines 67-68). In regard to claim 31, since Shih et al. teach

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an optimal gate recess depth of 0.25 microns, it is within the art of ordinary skill to provide an upper surface of the recess of less than 1 micron. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the MOSFET of Prior Art Figures 1 and 3a-3b and the MOSFET having conductive vias of Gilbert et al. with the FET having the gate recess depth of Shih et al. to achieve high power operation (col. 61-68).

Claims 28, 34 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Prior Art Figures 1 and 3a-3b and Gilbert et al. (5,349,224) as applied to claim 23-24 above, and further in view of Singh et al. (5,960,311).

Prior Art Figures 1 and 3a-3b and Gilbert et al. teach all mentioned in the rejections above. However, Prior Art Figures 1 and 3a-3b and Gilbert et al. fail to teach a dielectric layer extending from a region equal to or less than about 1 micron. Singh et al. teach a dielectric layer extending from a region from 0.5 to 1.2 microns (col. 5, lines 24-26). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the MOSFET of Prior Art Figures 1 and 3a-3b and the MOSFET having conductive vias of Gilbert et al. with the MOSFET having a dielectric layer extending from a region of Singh et al. to increase the speed of integrated circuits (col. 3, lines 33-36).

### ***Response to Arguments***

Applicant's arguments filed 11-13-02 have been fully considered but they are not persuasive.

In response to the remarks concerning Admitted Prior Art Figures 1 and 3a-3b not disclosing source/body contact regions laterally spaced apart from the gate conducting layer, Admitted Prior Art Figures 1 and 3a-3b does disclose the source/body contact regions 18 laterally spaced apart from the gate-conducting layer 12 by way of the gate oxide layer 24. Further, the source/body contact regions 18 does non-interruptibly contact the source region 26

The Beacom reference has been eliminated from the Office Action completely. Therefore, remarks concerning the Beacom reference are moot.

In response to the remarks concerning the Gilbert et al. reference, the conductive via is under the source electrode 90 and above the exposed portion of the P+ source/body contact region the sits to the left of the N+ region. Therefore, the conductive via of Gilbert et al. does extend between the source electrode and the source/body contact regions.

### ***Conclusion***

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following patents are cited to further show the state of the art with respects to trench-gated MOSFETs with source/body contact regions:

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Brush et al. (US 2001/0022379 A1)

Darwish et al. (6,008,520)

Hshieh et al. (5,629,543)

Mo (US 2001/0023104 A1).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ida M Soward whose telephone number is 703-305-3308. The examiner can normally be reached on Monday - Thursday, 6:30 am to 7:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 703-308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-308-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

ims  
December 18, 2002

  
AMIR ZARABIAN  
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